

GAO

United States General Accounting Office

Report to Congressional Committees

May 2000

DEFENSE ACQUISITIONS

F/A-18E/F Aircraft Does Not Meet All Criteria for Multiyear Procurement



DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited



G A O

Accountability * Integrity * Reliability

GAO/NSIAD-00-158

DEC QUALITY INSPECTED 1

20000601 085

Contents

Letter		3
Appendixes		
	Appendix I: Key Performance Parameters	18
	Appendix II: Average Ratings Comparing F/A-18E/F and F/A-18C Performance	20
	Appendix III: Members of Noise and Vibration Panel	21
	Appendix IV: Comments From the Department of Defense	22
	Appendix V: GAO Contacts and Staff Acknowledgments	27
Related GAO Products		28
Tables		
	Table 1: Objective, Threshold, and Demonstrated Performance Relative to Key Performance Parameters	18
	Table 2: Operational Testers' Average Ratings of F/A-18E/F and F/A-18C Operational Effectiveness	20
Figures		
	Figure 1: Operational Testers' Comparisons of F/A-18E/F and F/A-18C Operational Effectiveness	9

Abbreviations

DOD Department of Defense



United States General Accounting Office
Washington, D.C. 20548

National Security and
International Affairs Division

B-285119

May 26, 2000

Congressional Committees

Section 124 of the Strom Thurmond National Defense Authorization Act for Fiscal Year 1999¹ requires us to review the Navy's F/A-18E/F aircraft program and report annually to Congress until a full-rate production contract is awarded. The F/A-18E (single seat) and the F/A-18F (two seat) aircraft is intended to replace the F/A-18C (single seat), F/A-18D (two seat), A-6, and F-14 aircraft as they reach the end of their service life and are retired. The F/A-18E/F is designed primarily to meet the Navy's fighter escort, interdiction, fleet air defense, and close air support mission requirements. This is our second report under the congressional mandate and our fifth report overall on the F/A-18E/F program.

Our prior reports addressed the developmental test phase of the program. In June 1996, we recommended that, given the cost and marginal improvements in operational capabilities the F/A-18E/F would provide over existing F/A-18C/D aircraft, the Secretary of Defense should reconsider the decision to produce the E/F aircraft and, instead, procure additional F/A-18C/Ds.² In June 1999, we recommended that the Secretary of Defense defer multiyear funding for the F/A-18E/F program until all corrections of deficiencies had been incorporated into the aircraft's design and successfully tested.³ In its comments on these reports, the Department of Defense (DOD) disagreed with our recommendations. It stated that the F/A-18E/F would provide superior performance over the F/A-18C/D aircraft and that there were no deficiencies serious enough to warrant not awarding a multiyear contract. A list of our prior reports is at the end of this report.

This report focuses on the most recently completed phase of the program—operational test and evaluation. The objective of this phase was

¹ P.L. 105-261.

² *Navy Aviation: F/A-18E/F Will Provide Marginal Operational Improvement at High Cost* (GAO/NSIAD-96-98, June 18, 1996).

³ *Defense Acquisitions: Progress of the F/A-18E/F Engineering and Manufacturing Development Program* (GAO/NSIAD-99-127, June 15, 1999).

to field test the aircraft, under realistic conditions, to determine the effectiveness and suitability of the aircraft, its weapons, and its equipment for use in combat by typical military users.⁴ The operational test and evaluation report, issued in February 2000, stated that the F/A-18E/F was operationally effective and suitable and recommended its introduction into the fleet. The report was the basis for the Secretary of Defense's certification to Congress in April 2000 that the F/A-18E/F met its key performance parameters (see app.I). This certification was required before the Navy could enter into a multiyear procurement contract for full-rate production of the aircraft.⁵ Congress has 30 days to consider the Secretary's certification before the Navy can award a multiyear contract for full-rate production.

Our objectives during this review were to determine whether the operational tests (1) validated DOD's statements that the F/A-18E/F will provide performance capabilities that are superior to existing F/A-18 aircraft and (2) raised issues that could impact aircraft cost or the upcoming decision on whether the Navy should award a multiyear procurement contract for full-rate production of the aircraft.

Results in Brief

Although the F/A-18E/F met its key performance parameters, such as range and carrier suitability, the operational testers' comparisons of the F/A-18E/F to the existing F/A-18C showed that the F/A-18E/F did not demonstrate superior operational performance over the existing F/A-18C aircraft. The testers compared the operational effectiveness of the F/A-18C⁶ to the F/A-18E/F in 18 operational mission areas such as interdiction, fighter escort, combat air patrol, air combat maneuvering, and air-to-air weapons. Using a numerical scale, the testers rated the F/A-18E/F's operational effectiveness essentially the same as the F/A-18C's.

⁴ Operational effectiveness is the capability of the aircraft to perform its mission in the fleet environment and in the face of unexpected threats, including countermeasures. Operational suitability is the capability of the aircraft, when operated and maintained by typical fleet personnel in the expected numbers and of the expected experience level, to be supportable when deployed.

⁵ Certification by the Secretary of Defense is required by section 121 of the National Defense Authorization Act for Fiscal Year 2000.

⁶ The operational effectiveness comparison was made with only the existing F/A-18C because the Navy does not use the F/A-18D aircraft. The Marine Corps uses the D model.

Deficiencies identified by the operational testers will be costly to correct and raise questions about whether the Navy should enter into a multiyear procurement contract for full-rate production of the aircraft.

- The major deficiency was the aircraft's weak aerodynamic performance, which reduces the aircraft's ability to accelerate, climb and turn, and causes it to have a low top speed. These deficiencies reduce the aircraft's ability to maneuver during air-to-air combat with adversary aircraft; quickly exit a combat area so as to not get caught from behind; protect the carrier battle group by sprinting out to engage enemy aircraft; and integrate into operations with the better performing F/A-18C aircraft. Correcting these deficiencies would require a costly program to develop and acquire a new engine and retrofit it on already produced aircraft. The Navy does not currently plan to develop a new engine for the F/A-18E/F to correct these deficiencies because it believes that future upgrades to the aircraft—such as the Joint Helmet Mounted Cueing System and the AIM-9X missile—will provide capabilities that will make the speed and maneuverability of the aircraft less critical in close-in aerial combat.⁷ However, these two upgrades are still under development and testing. The Joint Helmet Mounted Cueing System is expected to be available when the F/A-18E/F is scheduled to enter the fleet in 2002; however, the AIM-9X will not be available at that time. In addition, these upgrades will not correct the F/A-18E/F's inability to quickly exit a combat area or to protect the fleet by sprinting out to engage enemy aircraft.
- The F/A-18E/F also has a noise and vibration deficiency that damages the air-to-air and some air-to-ground weapons carried by the aircraft. As a result, during operational testing, limits were imposed on the number of hours the weapons could be carried on the aircraft before they needed to be replaced, and more frequent weapon inspections were imposed. The operational testers concluded that the time limits and the more frequent inspections would not be acceptable for fleet operations and, therefore, rated the F/A-18E/F unsatisfactory in the air-to-air weapons area. The Navy's current approach to mitigating this problem is to strengthen the weapons, rather than make costly changes to the aircraft. A panel of experts assembled by the Navy to study the noise and vibration problem, however, stated that if further testing reveals damage to the weapons' electronic components, modifications to the

⁷ The Joint Helmet Mounted Cueing System will enable pilots to aim the AIM-9X missile, which is an improved short-range weapon, by turning their heads and looking at the target.

aircraft's wing might be needed. Testing is being done to determine the full extent of the noise and vibration damage to the weapons, identify the root causes of the problem, and develop fixes to correct the problem. However, this testing will not be completed and analyzed prior to the scheduled award of a multiyear procurement contract in early June 2000. Until the noise and vibration testing has been completed and corrections of the deficiency have been identified, the Navy will not have demonstrated that the F/A-18E/F wing has a stable design and, therefore, the program will not have met a key legislative criterion for a multiyear procurement contract for full-rate production of the aircraft.

To avoid costly retrofitting and redesign of the F/A-18E/F's wing because of the noise and vibration problem, we believe Congress should consider directing the Navy to defer the award of a multiyear contract for full-rate production of the F/A-18E/F until corrections of the problem have been made, tested, and funded. In written comments on a draft of this report, DOD disagreed with our matter for congressional consideration and stated that the F/A-18E/F is ready for full-rate production. Based on our analysis of DOD's comments, we have not changed our suggestion to Congress.

Background

The F/A-18E/F program began in May 1992 when the aircraft was approved as a major modification to existing F/A-18C/D aircraft. The F/A-18E/F was intended to provide improvements in range, the number of weapons the aircraft could carry, the amount of unused weapons and fuel the aircraft could return to the carrier with, survivability over existing F/A-18 aircraft, and space for future avionics systems. According to the most current Selected Acquisition Report⁸ dated December 31, 1999, the total cost of the F/A-18E/F program will be about \$47 billion in then-year⁹ dollars to procure 548 aircraft.

In June 1996, we reported that the unit recurring flyaway cost¹⁰ of the F/A-18E/F was about \$53 million in fiscal year 1996 dollars, compared to

⁸ Summary status reports on DOD's major acquisition programs that are submitted annually to Congress. The reports include key cost, schedule, and technical information.

⁹ Then-year dollars include estimated inflation for the years in which the expenditures are expected to occur.

¹⁰ Recurring flyaway costs include costs related to the production of the basic aircraft such as the airframe, engine and avionics.

about \$28 million for the existing F/A-18C aircraft. At the time of our 1996 report, the Navy was reporting that it planned to buy 1,000 F/A-18E/Fs. However, we reported that since the Marine Corps was not planning to buy the F/A-18E/F, the number of aircraft to be bought should be reduced in computing unit costs. We determined that eliminating aircraft for the Marine Corps reduced the probable number of aircraft to be procured to 660 aircraft. Therefore, the cost estimates in our June 1996 report were based on buying 660 F/A-18E/F aircraft. The number of aircraft to be procured has since been reduced to 548. We have not recalculated the cost differences between the F/A-18E/F and F/A-18C/D using the 548 aircraft procurement plan.

From May 1999 through November 1999, the F/A-18E/F underwent operational test and evaluation to determine its probable effectiveness and suitability in combat operations. The operational test team, comprised of 23 aircrew members from the Navy's Operational Test and Evaluation Force, completed over 800 operational test flights using the 7 aircraft produced during the earlier low-rate production phase of the program. The test team focused on assessing the aircraft's operational performance against a set of critical operational issues such as interdiction, fighter escort, and combat air patrol (see app.II) and key performance parameters such as range and carrier suitability (see app.I). The flight tests were conducted at the Naval Air Station, Key West, Florida; Naval Air Weapons Station, China Lake, California; U.S.S. John C. Stennis aircraft carrier; and Nellis Air Force Base, Las Vegas, Nevada.

The Director of Operational Test and Evaluation, in the Office of the Secretary of Defense, reviewed and approved the operational test plan, monitored the day-to-day conduct of the test, analyzed the operational test results, and reported the results of the analysis to the Secretary of Defense, the Under Secretary of Defense for Acquisition, and the congressional defense committees in March 2000. Like the operational testers, the Director found that although the F/A-18E/F had some deficiencies, overall the aircraft was operationally effective and suitable; however, he also identified a number of concerns—such as the noise and vibration problem that led to an unsatisfactory evaluation in air-to-air weapons—and made recommendations, which we discuss later in this report.

The next decision point in the F/A-18E/F program is whether the Navy should award a multiyear contract for full-rate production of the aircraft. Title 10 U.S.C., section 2306b contains the criteria that must be met for an agency to enter into multiyear contracts. Those criteria include the ability

to obtain significant cost savings, an adequately validated requirement, a stable system design, and a commitment to stable funding over the life of the multiyear contract.

Operational Testers' Ratings Show That F/A-18E/F Does Not Provide Performance Superior to F/A-18C

In our 1996 report, we concluded that the F/A-18E/F provided a marginal increase in capability when compared to the F/A-18C/D. For example, we reported that while the F/A-18E/F provided some increased range, the increased range was achieved at the expense of sustained turn rate,¹¹ maneuvering, and acceleration. The operational testers' comparisons of the operational effectiveness of the two aircraft during the recently completed operational test and evaluation phase confirm our earlier conclusion.

The operational testers compared the operational effectiveness of the F/A-18E/F and F/A-18C in 18 mission areas using the following numerical scale.

0 Same in both the E/F and the C

+1 Slightly better in the E/F compared with the C

+2 Much better in the E/F compared with the C, or absent in the C

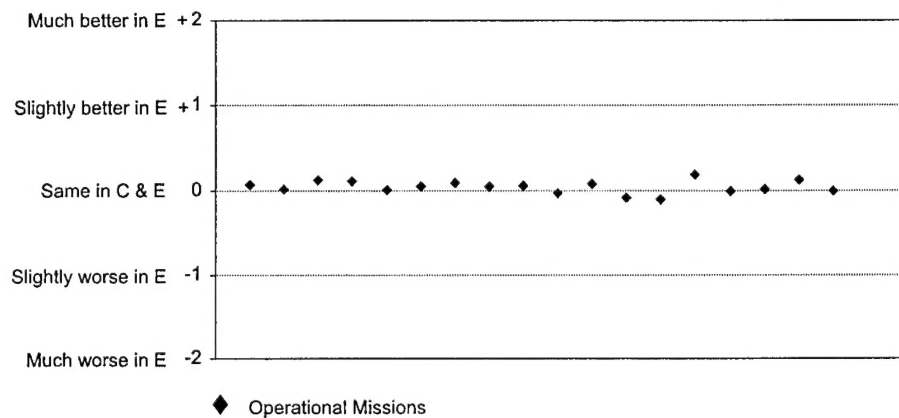
-1 Slightly worse in the E/F compared with the C

-2 Much worse or absent in the E/F compared to the C

As shown in figure 1, the operational testers rated the F/A-18E/F's operational effectiveness essentially the same as the F/A-18C's in each of the 18 operational mission areas. The ratings represent the average score given to each of the operational mission areas by the 14 test pilots and the 9 weapon systems officers.

¹¹ The maximum rate of turn, measured in degrees per second, the aircraft can sustain without losing speed.

Figure 1: Operational Testers' Comparisons of F/A-18E/F and F/A-18C Operational Effectiveness



Source: Calculated using operational testers' scores.

Appendix II shows the average ratings of all the testers for each of the 18 operational mission areas in figure 1.

These ratings notwithstanding, the Commander, Operational Test and Evaluation Force, in the final operational test and evaluation report, recommended that the E/F be introduced into the fleet. This recommendation was based on the weight the operational testers gave to the E/F's attributes—such as the ability to carry more weapons and to function as a tanker—and, with the exception of an unsatisfactory rating in the air-to-air weapons and sensor performance mission areas, the aircraft satisfactorily met the other operational mission requirements.

Testing Raised Issues That Will Be Costly to Correct and Affect Multiyear and Full-Rate Production

The February 2000 classified operational test report by the Commander, Operational Test and Evaluation Force identified 27 major deficiencies and 88 minor deficiencies with the F/A-18E/F and stated that the major deficiencies should be corrected as soon as possible. The major deficiencies included such things as the aerodynamic performance of the aircraft—slow top speed, slow acceleration and sustained turn rate—and frequency of inspections and damage to air-to-air and air-to-ground weapons. Correcting these deficiencies will be costly.

Aerodynamic Deficiencies Will Be Costly to Correct

Five of the 27 major deficiencies identified by the operational testers related to the E/F's aerodynamic performance. Correcting these deficiencies will most likely require a new engine—a costly solution that the Navy is not pursuing at this time. Instead, the Navy plans to mitigate the E/F's aerodynamic shortcomings with future upgrades to the aircraft.

In March 2000, the DOD Director of Operational Test and Evaluation testified before the Senate Committee on Armed Service's Airland Forces Subcommittee that the E/F's maneuvering performance is constrained by the aircraft's basic aerodynamics and the thrust of its engines. He stated that the Navy will have to live with these performance limitations unless it undertakes a major effort to redesign or reengineer the aircraft.

Navy program officials stated that correcting the aircraft's aerodynamic deficiencies would require developing a new engine. These officials also stated that there are currently no plans to redesign or re-engine the aircraft. They believe that the Navy pilots in the fleet will be willing to accept the E/F's aerodynamic performance, particularly in view of upgrades planned for the aircraft. These officials believe that the upgrades—such as the Joint Helmet Mounted Cueing System and the AIM-9X missile—will mitigate the F/A-18 E/F's maneuvering deficiencies as it relates to close-in aerial combat. The AIM-9X missile program is intended to provide an improved short-range missile with full day and night capability, increased resistance to countermeasures, and improved target acquisition capability over the existing AIM-9 missile. The AIM-9X missile is to be used in conjunction with the Joint Helmet Mounted Cueing System, which will enable pilots to aim the missile by turning their heads and looking at the target rather than having to maneuver the aircraft to the target. As a result, the operational testers believe that the speed and maneuverability of the aircraft become less critical. However, the Joint Helmet Mounted Cueing System and the AIM-9X are still under development and testing. The AIM-9X will not be available when the F/A-18E/F is scheduled to enter the fleet in 2002.

Our review of operational test data showed that the pilots conducting the operational tests were not just concerned about slow speed in close-in aerial fights. They were also concerned about whether the aircraft will have the necessary speed to enter and exit threat areas, whether the F/A-18E/F will have the speed needed to sprint out to engage enemy aircraft in order to defend the carrier battle group (referred to as the deck-launch-intercept mission), and whether the aircraft will be able to keep up with the faster and more maneuverable F/A-18Cs and other Air Force tactical aircraft. The

Joint Helmet Mounted Cueing System and the AIM-9X missile will not correct these concerns.

Program officials indicated that addressing the aircraft's maneuvering deficiencies might require the development of a higher thrust engine, which would add to the cost of the aircraft. These officials stated that the Navy will have to consider such an alternative if, in the future, the pilots operating the aircraft in the fleet decide that the F/A-18E/F's performance in these areas needs improvement. Modifying the current F414 engine, which was developed specifically for the F/A-18E/F, is not an option because it cannot be improved to provide significantly more thrust. If a new engine is needed, development and procurement costs for subsequent F/A-18E/Fs will increase, and additional costs to retrofit already produced F/A-18E/Fs will be incurred.

Noise and Vibration
Problem Needs Resolution
Before Multiyear
Procurement and Full-Rate
Production

During development and operational testing, the F/A-18E/F experienced what is referred to as noise and vibration under the aircraft's wing that damaged the air-to-air and some air-to-ground weapons. Testing disclosed support structure cracks, loose screws, broken springs, delamination of the weapons' fins, and guidance and control failures. As a result, during operational testing, limits were imposed on the number of hours the weapons could be carried on the aircraft before they were to be replaced, and more frequent weapon inspections were imposed. For example, a 50-hour service life was imposed for the AIM-120 AMRAAM missile on the E/F as compared to 450 hours service life on the F/A-18C/D and a 10-hour service life was imposed for the AIM-7 missile compared to 500 hours for the F/A-18C/D. Although the details of the inspection intervals are classified, the intervals used during operational testing were in excess of normal fleet procedures. The operational testers concluded that the limits on the time the weapons could be carried on the aircraft before they were required to be replaced and the more frequent inspection requirements would not be acceptable in the fleet and, therefore, rated the E/F unsatisfactory in the air-to-air weapons mission area.

In his March testimony, the Director of Operational Test and Evaluation stated that the noise and vibration under the F/A-18E/F's wings is more severe than on the F/A-18C/D. He stated that the problem raises special concerns about the ability of the F/A-18E/F to get the full amount of service time out of the weapons stored on the wings before they must be replaced. If not corrected, the overall effectiveness and suitability of the F/A-18E/F for fleet operations would be significantly jeopardized. Accordingly, he

recommended that DOD pay close attention to the Navy's efforts to ameliorate the noise and vibration problem.

Noise and vibration on the F/A-18E/F is not a new issue. It was detected during earlier developmental testing in September 1997. In October 1999, the F/A-18E/F program office assembled a panel of experts to evaluate its plan for addressing the noise and vibration problem. (See app. III for a list of panel members.) At the time, the panel agreed that expensive aircraft modifications did not appear to be warranted. However, the panel indicated that it might be prudent to modify the F/A-18E/F's wing design, if additional testing revealed damage to sensitive weapon electronic components carried by the E/F aircraft.

The F/A-18E/F program office is conducting additional development testing to determine the full extent of noise and vibration damage to various weapons, identify the root cause of the problem, and develop fixes to correct the problem. The testing and analysis had not been completed as of April 2000. However, program office officials do not anticipate that costly changes to the aircraft's wing structure will be needed to correct or mitigate the noise and vibration damage to weapons carried on the aircraft's wing. Instead, they anticipate that ongoing tests will confirm that strengthening missile components and fasteners will address the external weapons damage identified during testing.

The panel was reconvened in March 2000 to review the results of testing completed up to that point. The panel members reiterated their earlier position that expensive aircraft modifications did not appear to be warranted. However, they again did not rule out changes to the wing design if additional, but yet unscheduled, testing revealed significant damage to sensitive weapon electronic components.

Conclusions

After considering the performance and major deficiencies and major enhancing characteristics demonstrated by the F/A-18E/F during operational test and evaluation, the Director, Operational Test and Evaluation Force concluded that the aircraft was operationally effective and suitable and recommended that it be introduced into the Navy fleet. Moreover, the Secretary of Defense has decided that the Navy should be allowed to award a multiyear procurement contract for full-rate production of the aircraft. Congress must decide by early June 2000 whether it is fiscally prudent for the Navy to enter into a multiyear procurement

contract for full-rate production of the aircraft, given the deficiencies identified in the aircraft.

We believe that the noise and vibration problem, which was first discovered in September 1997 during developmental testing and is still evident, warrants careful consideration and resolution before the Navy commits to a multiyear contract for full-rate production of the aircraft. The expert panel that continues to study this problem has stated as recently as March 2000 that the unscheduled testing must be completed to determine the significance of this problem. To go into full-rate production without having first resolved this problem risks having to undertake a costly wing redesign of aircraft on contract and a retrofit program to correct the deficiency on aircraft that will have already been produced by the time a correction has been identified and is ready for integration on the aircraft.

Matter for Congressional Consideration

To avoid costly retrofitting and redesign of the F/A-18E/F's wing because of the noise and vibration problem, we believe Congress should consider directing the Navy to defer awarding a multiyear contract for full-rate production of the F/A-18E/F until testing related to the noise and vibration problem has been completed and corrections of the deficiency have been made, tested, and funded.

Agency Comments and Our Evaluation

In written comments on a draft of this report, the Director of Strategic and Tactical Systems, within the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, disagreed with our matter for congressional consideration. DOD's comments are reprinted in appendix IV. DOD stated that (1) none of the conclusions of the expert panel that is monitoring the noise and vibration problem suggest that a wing redesign is necessary, (2) the program meets the stability of design criterion for multiyear procurement, and (3) delaying the multiyear contract award would increase program costs.

In our view, DOD's comments substantiate our findings that the noise and vibration issue has not been resolved and will not be resolved prior to the scheduled award of a multiyear contract. To meet the design stability criterion for multiyear procurement, DOD will need to obtain a thorough understanding of the characteristics and magnitude of the plane's aerodynamic problems, identify the root causes of the problem, identify and test potential solutions, and then select the most appropriate solution

from a cost-benefit standpoint. DOD does not yet have this information. In its comments, DOD pointed out that the issues associated with noise and vibration will continue to be vigorously, thoroughly, and comprehensively addressed. As we pointed out in our report, the expert panel has not ruled out changes to the wing design if additional testing reveals significant damage to sensitive weapons electronic components. Moreover, the expert panel stated that if DOD's current approach to mitigating the noise and vibration problem—strengthening the weapons the aircraft carries—is not acceptable, the fix that would have the highest likelihood of successfully resolving the problem would be to modify the shape of the wing. Testing potential fixes to the noise and vibration problem will not be completed until after the scheduled multiyear contract for full-rate production of the aircraft is awarded in June 2000.

Going forward with a multiyear contract and then having to redesign the wing to correct the noise and vibration problem during production, if future testing indicates a redesign is necessary, would be significantly more costly than correcting it before full-rate production begins. In that regard, our work on other weapon system programs demonstrates that correcting a problem while a program is still in engineering and manufacturing development is significantly less costly than correcting it during the production phase. The additional cost would have to be offset against the savings that DOD is projecting under a multiyear contract.

In summary, DOD's comments do not provide any information that would cause us to revise our findings and as a result, we have not changed our suggestion that Congress direct the Navy to defer awarding a multiyear contract for the full-rate production of the F/A-18E/F until further testing related to the noise and vibration problem has been completed and corrections of the deficiency have been made, tested, and funded.

Scope, Methodology, and Access Issues

To determine whether the operational tests validated DOD's statements that the F/A-18E/F would provide performance that is superior to existing F/A-18 aircraft, we used the comparative data that the operational testers included in End-of-Test Survey questionnaires that were completed at the end of operational testing. This survey required the testers to rate the E/F's performance against the F/A-18C in each of the 18 mission areas assessed during operational test and evaluation.

To identify issues that could impact aircraft cost or the upcoming decision on whether to award a multiyear procurement contract for full-rate

production of the aircraft, we performed a detailed analysis of the Operational Test and Evaluation Force's test plan and Test Information Management System database. This database contained the results of over 800 individual flight tests and the comments recorded by aircrew members at the conclusion of the individual flight tests. We also used the End-of-Test Survey because one part contained the operational testers' ratings of the acceptability of the F/A-18E/F to carry out its various missions. The testers included both positive and negative comments to describe their assessment of the aircraft.

Accomplishing each of our objectives also included interviewing officials within the office of DOD's Director, Operational Test and Evaluation and in the Navy's Operational Test and Evaluation Force, including the test director who flew the operational flight tests, to obtain their assessment of the aircraft's current and potential performance. We observed the operational tests during a visit to the U.S.S. John C. Stennis aircraft carrier and exercises at Nellis Air Force Base.

Public Law 105-261, which required us to conduct this review, also required us to certify whether we had access to sufficient information to make informed judgments on the matters discussed in this report. We obtained sufficient information to make informed judgments; however, we obtained the required information only after substantial delays by DOD and the Navy. We requested access to the operational test results as they became available during operational testing, which began in May 1999, but DOD and the Navy refused that access. They ultimately agreed to provide us the required data only after the flight test program was completed in November 1999. The End-of-Test Survey questionnaires were not made available to us until the operational test report was issued on February 14, 2000. While these delays complicated our work, they did not preclude us from making the judgments contained in this report.

We conducted our review from June 1999 through April 2000 in accordance with generally accepted government auditing standards.

We are sending copies of this report to the Honorable William Cohen, Secretary of Defense; the Honorable Richard Danzig, Secretary of the Navy; and the Honorable Jacob Lew, Director, Office of Management and Budget. Copies will also be made available to others on request.

Please contact me at (202) 512-4841 if you or your staff have any questions concerning this report. Additional points of contact and key contributors to this report are listed in appendix V.

A handwritten signature in cursive script, reading "Louis J. Rodrigues". The signature is written in black ink and is positioned above the printed name and title.

Louis J. Rodrigues
Director, Defense Acquisitions Issues

List of Congressional Committees

The Honorable John W. Warner
Chairman
The Honorable Carl Levin
Ranking Minority Member
Committee on Armed Services
United States Senate

The Honorable Ted Stevens
Chairman
The Honorable Daniel K. Inouye
Ranking Minority Member
Subcommittee on Defense
Committee on Appropriations
United States Senate

The Honorable Floyd D. Spence
Chairman
The Honorable Ike Skelton
Ranking Minority Member
Committee on Armed Services
House of Representatives

The Honorable Jerry Lewis
Chairman
The Honorable John P. Murtha
Ranking Minority Member
Subcommittee on Defense
Committee on Appropriations
House of Representatives

Key Performance Parameters

The F/A-18E/F key performance parameters are defined in table 1. The objective requirement is the desired performance value for the parameter. The threshold requirement is the minimum acceptable performance value that is necessary to satisfy the operational need. The table shows that the E/F did not meet all objective requirements (carrier suitability, useable load factor, specific excess power, and acceleration) but met the lower threshold requirements for each key performance parameter.

Table 1: Objective, Threshold, and Demonstrated Performance Relative to Key Performance Parameters

Title of parameter	Objective	Threshold	Demonstrated (E/F)
Deck Spot Factor ^a	< 1.4	< 1.5	1.46
Fighter escort radius ^b	> 425 nautical miles (nm)	> 410 nautical miles (nm)	462 nautical miles (no F requirement)
Interdiction mission radius ^c			
2-480 Gallon external tanks	> 400 nm	> 390 nm	444 nm/397 nm
3-480 Gallon external tanks	> 450 nm	> 430 nm	496 nm/451 nm
Combat ceiling ^d	> 50,000 feet above mean sea level	> 50,000 feet above mean sea level	52,300/52,000 feet
Recovery payload ^e	> 9,000 pounds	> 9,000 pounds	9,500 pounds
Carrier suitability ^f			
Launch Wind Over Deck	< 25 knots	< 30 knots	28 knots
Recovery Wind Over Deck	< 10 knots	< 15 knots	8/13 knots
Approach Speed	< 140 knots	< 150 knots	142/145 knots
Useable load factor ^g	> +7.5 g	> +7.5 g	7.5 g
Specific excess power ^h	> 650 feet per second	> 600 feet per second	648/644 feet per second
Acceleration ⁱ (0.8M to 1.2M @ 35K feet)	< 60 seconds	< 70 seconds	65/65 seconds
Additional internal fuel ^j (over that of the F/A-18C/D)	> 3,000 pounds	> 3,000 pounds	3,828/3,613

^aSize of F/A-18E/F relative to F/A-18C/D. Smaller is better.

^bOne way unrefueled range using internal fuel and no external fuel tanks. More is better.

^cOne way unrefueled range using external fuel tanks. More is better.

^dAltitude at which aircraft can effectively perform combat missions. Higher is better.

^eWeight of aircraft, weapons, and fuel at which the aircraft can land safely on the carrier deck. More is better.

Appendix I
Key Performance Parameters

^fAmount of wind over the carrier deck required for takeoff and landing, and the airspeed at which the aircraft can safely land on the carrier deck. Low amount of wind over the deck and slow approach speed are better.

^gDepicts the structural strength limits of the aircraft, expressed in terms of g force. Higher usable loads allow for more radical aircraft maneuvering.

^hIncreased number of feet per second the aircraft will travel when afterburners are engaged when flying at .9 mach and 10,000 feet altitude. More is better.

ⁱNumber of seconds it takes the aircraft to accelerate from .8 mach to 1.2 mach at 35,000 feet. Less is better.

^jAmount of additional internal fuel that the F/A-18E/F must be able to carry relative to the F/A-18C/D. More is better.

Average Ratings Comparing F/A-18E/F and F/A-18C Performance

Table 2 shows the average ratings, based on evaluations by the 14 operational test pilots and 9 weapon systems officers, comparing the operational effectiveness of the F/A-18E/F with the F/A-18C/D in each of the 18 mission areas included in the comparison.

Table 2: Operational Testers' Average Ratings of F/A-18E/F and F/A-18C Operational Effectiveness

Mission area number	Mission area title	Average rating
1	Interdiction	0.08
2	War-at-sea	0.02
3	Fighter escort	0.13
4	Combat air patrol	0.12
5	Deck launched interceptor	0.01
6	Air combat maneuvering	0.05
7	Defense suppression	0.10
8	Close air support	0.05
9	Forward air controller	0.06
10	Air-to-ground sensor performance	-0.02
11	Air-to-ground weapons	0.09
12	Air-to-air sensor performance	-0.08
13	Air-to-air weapons	-0.10
14	Survivability	0.20
15	Command, control, and communication	0.00
16	Mine warfare	0.02
17	Mobility	0.13
18	Joint interoperability	0.00

Note: Key to relative ratings.

0 Same in both the E/F and the C

+1 Slightly better in the E/F compared with the C

+2 Much better in the E/F compared with the C, or absent in the C

-1 Slightly worse in the E/F compared with the C

-2 Much worse or absent in the E/F compared with the C

Members of Noise and Vibration Panel

Dr. Richard Wallace
Office of the Secretary of Defense (Chairman)

Dr. Robert Hall
National Aeronautics and Space Administration
Langley Research Center

Dr. Craig Lee
Raytheon, Texas

Mr. Mel Luter
Naval Air Systems Command (Retired)

Mr. George Maggos
Naval Air Systems Command (Retired)

Mr. Bob Newell
Lockheed Martin

Mr. Bob Pearson
Boeing
Long Beach, California

Mr. Bill Reed
National Aeronautics and Space Administration
Langley Research Center (Retired)

Mr. Edward Stricklin
U.S. Air Force
Eglin Air Force Base

Comments From the Department of Defense

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



ACQUISITION AND
TECHNOLOGY

OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON
WASHINGTON DC 20301-3000

9 MAY 2000

Mr. Louis J. Rodrigues
Director, Defense Acquisitions Issues
National Security and International Affairs Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Rodrigues:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "DEFENSE ACQUISITIONS: F/A-18E/F Aircraft Does Not Meet All Criteria for Multiyear Procurement for Full-Rate Production," dated April 28, 2000 (GAO Code 707431/OSD Case 1988).

The Department nonconcurs with the GAO recommendation that Congress direct the Navy to defer awarding a multiyear contract for full-rate production of the F/A-18E/F until further testing related to the noise and vibration problem has been completed and corrections of the deficiency have been made, tested, and funded. The issues associated with noise and vibration were, and continue to be, vigorously, thoroughly, and comprehensively addressed. All of the testing, incorporated fixes, and data results, as well as the Navy's entire approach to addressing the noise and vibration issue, have been monitored by a panel of experts intimately familiar with similar issues faced by most tactical aircraft programs. The F/A-18E/F program is pursuing the same strategy as the F-15E, F-16, F-111, A-7, AV-8B and B-1B programs. None of the panel conclusions suggests that a wing redesign is part of the solution set.

The GAO report, required by section 124 of P.L. 105-261, reviews the operational test and evaluation (OPEVAL) portion of the F/A-18E/F Super Hornet program. Operational testers, in an independent assessment, determined the aircraft to be operationally suitable and operationally effective. Subsequently, the Director, Operational Test and Evaluation independently assessed the F/A-18E/F performance and found the aircraft both operationally effective and suitable. This was reported to Congress in the required Beyond Low Rate Initial Production report dated March 30, 2000. The GAO recognized the fact that F/A-18E/F achieved the highest marks possible for OPEVAL. The assertion that passing marks were a result of enhancements and disproportionate weighting of deficiencies is incorrect.

Some of the deficiencies identified by the operational testers were not new discoveries. Legacy sensor systems, with documented performance shortfalls, are known to both the Navy and the GAO. Corrections for these deficiencies have been identified and solutions are in work. GAO's suggestion that fixes are not known at this time is not accurate. Many identified corrections are incorporated into the first lot of Full-Rate Production aircraft, and the costs associated with those corrections are incorporated into multiyear contract pricing.



See comment 1.

See comment 2.

Appendix IV
Comments From the Department of Defense

The F/A-18E/F meets or exceeds all of its Key Performance Parameters (KPPs) established in the Operation Requirements Document and approved by the Joint Requirements Oversight Council. The aircraft, in an "as is" configuration, was determined ready for fleet introduction by the Director, Operational Test and Evaluation.

The Navy plans to enhance overall air-to-air and air-to-ground performance with roadmap systems such as the Joint Helmet Mounted Cueing System, the AIM-9X Sidewinder missile, the Advanced Electronic Scanned Array radar, and the Advanced Targeting Forward Looking Infra Red system. These enhancements will join the program throughout the next several years and provide warfighter system enhancements that embrace emerging technologies and integration, addressing many of the GAO-perceived current weaknesses. A phased integration effort for these systems will ensure increased weapons system capability consistent with the benchmark operational qualities of increased survivability, payload, range, bring-back, and growth.

See comment 3.

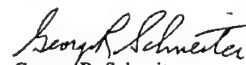
The F/A-18E/F has met all of the criteria necessary to enter into a multiyear procurement by satisfying the statutory requirements of Title 10 Section 2306b of title 10, United States Code. The program has demonstrated it provides substantial savings (over \$700M); a stable requirement (validated by the Joint Requirements Oversight Council as a replacement for the F/A-18C/D and F-14); funding stability (approved by the President's budget); a stable design that minimizes the technical risk (validated by continued testing); a realistic cost estimate (as determined by the Naval Center for Cost Analysis with methodology endorsed by the DoD Cost Analysis Improvement Group); and will promote national security (validated by the QDR recommended replacement of the F-14).

See comment 4.

Suggested technical changes for clarification and accuracy have been provided separately.

The Department appreciates the opportunity to comment on the draft report.

Sincerely,


George R. Schneiter
Director
Strategic and Tactical Systems

Enclosure

GAO DRAFT REPORT DATED APRIL 28, 2000
(GAO CODE 707431/OSD CASE 1988)

"DEFENSE ACQUISITIONS: F/A-18E/F AIRCRAFT DOES NOT MEET ALL CRITERIA
FOR MULTIYEAR PROCUREMENT FOR FULL-RATE PRODUCTION"

DOD COMMENTS ON THE "MATTER FOR CONGRESSIONAL CONSIDERATION"

GAO SUGGESTION: To avoid costly retrofitting and redesign of the F/A-18's wing because of the noise and vibration problem, we believe Congress should consider directing the Navy to defer awarding a multiyear contract for full-rate production of the F/A-18E/F until testing related to the noise and vibration problem has been completed and corrections of the deficiency have been made, tested, and funded. (p. 16/GAO Draft Report)

DOD RESPONSE: Nonconcur. The F/A-18E/F is ready for full-rate production. The Secretary of Defense has certified to Congress that the F/A-18E/F is operationally effective and operationally suitable, and meets its Key Performance Parameters. The program is on schedule and cost.

- A Blue Ribbon Panel was commissioned to study the noise and vibration deficiency. Based on Blue Ribbon Panel guidance and accomplished fixes, testing, and analysis, wing redesign risk has been minimized to acceptable thresholds to support the multiyear contract award. Consequently, the aircraft configuration is stable.
- Noise and vibration are aerodynamic phenomena that are experienced in all types of aircraft. High performance aircraft such as the F/A-18E/F have dynamic underwing environments that were unknown at the time of store/weapon design. The approach taken by the Navy and the contractor to solve the effect of the underwing environment on weapons is the same as taken on many other aircraft development programs including the F-15E, F-16, F-111, A-7, AV-8B and B-1B programs.
- Deferring the multiyear contract award would result in the loss of substantial cost savings.
- The F/A-18E/F program meets the statutory requirements of section 2306b of title 10 United States Code, by providing substantial savings through multiyear procurement (over \$700M); a stable requirement (validated by the JROC as a replacement for the F/A-18C/D and F-14); funding stability (approved by the President's budget); a stable design that minimizes technical risk (validated by extensive testing and achievement of all Key Performance Parameters); a realistic cost estimate (determined by the Naval Center for Cost Analysis with methodology endorsed by the DoD Cost Analysis Improvement Group); and will promote enhanced national security (validated by the QDR-recommended replacement of the F-14).

Now on p. 13.

See comment 5.

The following are GAO's comments on the Department of Defense's (DOD) letter dated May 9, 2000.

GAO Comments

1. Our intent was to show that while the operational testers found the F/A-18E/F to be operationally effective due to certain enhancing attributes, such as its ability to carry more weapons than the existing F/A-18C/D, they also rated the E/F's operational effectiveness essentially the same as the earlier C/D models. We accepted the operational testers' ratings and made no judgments on the appropriateness of the weights they assigned to enhancements versus deficiencies.
2. According to program documents, many of the 27 major deficiencies identified by the operational testers are still being investigated. Testing on potential fixes has not been completed and, in those instances where testing has been completed, DOD has not verified that the deficiencies have in fact been corrected.
3. Our report notes that DOD plans to enhance the overall performance of the F/A-18E/F with future systems such as the Joint Helmet Mounted Cueing System, the AIM-9X Sidewinder missile and that DOD believes these systems may mitigate the effects of the F/A-18E/F's aerodynamic shortcomings. We did not assess the status of these programs. Their integration on the F/A-18E/F is dependent on successfully completing their respective development programs.
4. DOD did not provide separate technical comments.
5. Meeting the key performance parameters means that the aircraft has successfully achieved specific aircraft capability requirements, such as range, acceleration, and the ability to bring unused weapons back onboard the carrier. However, key performance parameters are not measurements of the aircraft's ability to perform specific combat operations such as interdiction, fighter escort, and air-to-air combat. The noise and vibration problem directly affects the aircraft's ability to successfully perform these various operational missions. As we stated in our report, the Director of Operational Test and Evaluation testified in March 2000 before the Senate Committee on Armed Services that the noise and vibration problem, if not corrected, would significantly jeopardize the overall effectiveness and suitability of the F/A-18E/F for fleet operations. Our matter for congressional consideration is to make

Appendix IV
Comments From the Department of Defense

Congress aware of this risk as it weighs the merits of allowing the program to award a multiyear contract for full-rate production.

GAO Contacts and Staff Acknowledgments

GAO Contact

Steven Kuhta (202) 512-4328

**Staff
Acknowledgments**

Jerry Clark, Stacy Edwards, Noel Lance, and Carlos Garcia also made significant contributions to this report.

Related GAO Products

Navy Aviation: F/A-18E/F Will Provide Marginal Operational Improvement at High Cost (GAO/NSIAD-96-98, June 18, 1996).

F/A-18E/F Aircraft Production Decision Should Be Postponed (GAO/NSIAD-97-106R, Mar. 4, 1997).

Navy Aviation: F/A-18E/F Development and Production Issues (GAO/NSIAD-98-61, Mar. 13, 1998).

Defense Acquisitions: Progress of the F/A-18E/F Engineering and Manufacturing Development Program (GAO/NSIAD-99-127, June 15, 1999).